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THE SHAPES WE NEED

by Kurt Rowland

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NOTES FOR TEACHERS

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LOOKING
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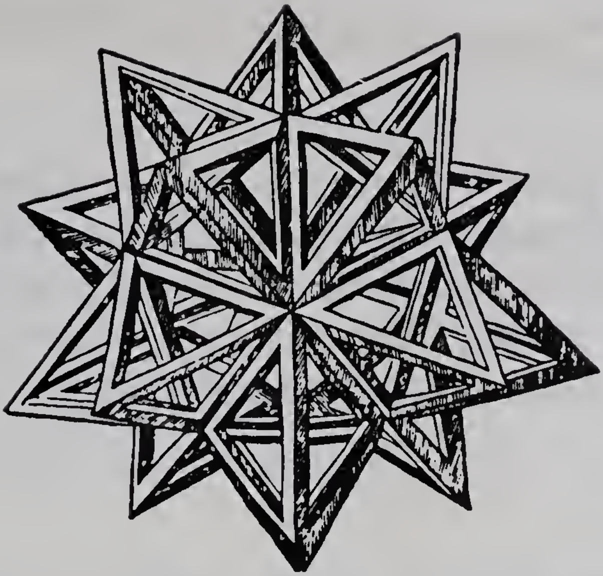
Part 3



THE SHAPES WE NEED

Notes for Teachers

by Kurt Rowland MSIA

Ginn and Company Ltd
18 Bedford Row
London WC1

The list of picture sources on pages 53-63 will indicate the many people who have provided me with photographs to illustrate the textbook, and I should like to offer all of them my sincere thanks. Unfortunately, however, it has not been possible to trace every copyright owner.

K. F. R.

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INTRODUCTION

Looking and Seeing, a course of four books, provides a training in visual understanding and discrimination: a course of visual education. Although in recent years much has been said and written about the importance of visual education, no textbook on the subject has yet appeared. Until now, anyone interested in teaching it has had to make up his own course or resort to books which deal, often from a specialist's point of view, with various aspects of vision, design, engineering, town planning, and so on. This is not only a complicated process in itself but involves a task of abstraction comparable to teaching first year biology from erudite books intended for medical students or biochemists.

The four parts of Looking and Seeing are, it is believed, the first school textbooks of visual education ever to be published. They present basic visual knowledge in easily graded chapters and, like so many books in other school subjects, include exercises involving activities of various kinds.

This is *not* a course of design appreciation with vague descriptions of well-designed objects. The author believes that the problem must be attacked at a deeper level, so that pupils will eventually acquire a foundation of knowledge on which to base sound visual judgments of their environment. Such informed judgments will replace the bewilderment and indifference so often found at present. The richer experience of the physical world made possible through Looking and Seeing will allow readers to enjoy new outlets for self-expression and will stimulate creative and positive attitudes.

The organisation of Looking and Seeing arises from a simple progression. Parts One and Two could be considered as a grammar of vision, in which the elements of which our visual world is composed are discussed and analysed. Parts Three and Four show how this grammar may be applied.

PART ONE/PATTERN AND SHAPE

Readers are encouraged to look at the world around them. Patterns feature prominently. They serve as a useful means of explaining and relating other concepts: for example, environment, social forces, character. In the last two chapters the idea of form is introduced.

PART TWO/THE DEVELOPMENT OF SHAPE

The story of form is continued, but on the level of technology. Tradition and modern materials impose their own aesthetic on the objects into which they are formed. This aesthetic is guided by a natural development, rather like the evolution of natural organisms, in which function asserts its supremacy.

PART THREE/THE SHAPES WE NEED

This part deals mainly with the two strands of design: the purely mechanical and mathematical, and the human. Ideally, the man-made world should be a synthesis of the two. This synthesis provides a visual language.

PART FOUR/THE SHAPE OF TOWNS

The town is considered as the most complicated and ambitious man-made shape. Basically we are here still grappling with design problems which confronted the early craftsmen, but on a very much vaster scale, one which is likely to increase in complexity within the next generation.

PLACE OF LOOKING AND SEEING WITHIN THE SCHOOL CURRICULUM

The subject matter of this course will be better understood when related to other school subjects. The relationship between society and pattern can be the subject of an historical study, the relationship between man's surroundings and the patterns he produces could be linked to geography. If crafts such as pottery or weaving are practised in the school a fruitful liaison could be established. The diagrams or drawings derived from a study of everyday patterns can be used in art lessons. In this way a cross-fertilisation will ensue; not only will the course gain in meaning through association with other subjects, but it will surely enrich these subjects as well. It will also introduce the idea that all fields of knowledge are somehow part of the same endeavour.

The exercises at the end of each chapter form an essential part of the course. If possible these should be executed in a book, or else on sheets of unruled paper or cartridge paper and kept in a folder. It is most important that past work should be available for reference, so that the growth of the pupil's ideas and vision can be surveyed by teacher and pupil. Furthermore, such notebooks should never be approached with any kind of formality. On the contrary, the children should be allowed to enter spontaneously, in graphic or literary form, any observations they think relevant, and to add any subsequent observations from time to time, even when this conflicts with ideas of neatness. The exercises are not meant simply to implement rules derived from the lessons; they aim to stimulate further ideas and individual initiative. This stimulation must be considered the most valuable part of the course. The subject matter of Looking and Seeing cannot possibly be absorbed in the same way by people of different temperaments and abilities. Some notebooks will undoubtedly be stronger on the literary side than on the visual, others may be more visually discriminating, but all readers will share an increase in creative power.

NOTES ON PART THREE: THE SHAPES WE NEED

Chapter 1 Mathematics in our surroundings

The mathematics of the living and the man-made world. Mathematical relationships found in the living world. Ratios, proportions, the Golden Section, the Fibonacci series, spirals. Mathematical principles, applied to man-made shapes such as bridges, bring us nearer to natural shapes.

In his great study of morphology 'On Growth and Form' D'Arcy Thompson shows how the whole field of natural shapes may be investigated by bringing the precision of mathematics to bear on biology. He was convinced that 'no organic forms exist save such as are in conformity with physical and mathematical laws'. He saw all forms in the living world as diagrams of forces 'whose permanence or equilibrium is explained by the interaction or balance of forces as described in statics'. He infused this astringent discipline into the main body of natural philosophy. 'Like warp and woof mechanism and teleology are interwoven together and we must not cleave to the one or despise the other; for their union is rooted in the very nature of totality.' This idea of totality is 'something exhibited not only by a lyre in tune, but by all the handiwork of craftsmen and by all that is put together by art or nature. It is the compositeness of any composite whole and implies a balance or attunement.' Life cannot be viewed in its totality without a basic understanding of the mathematical and physical laws of nature.

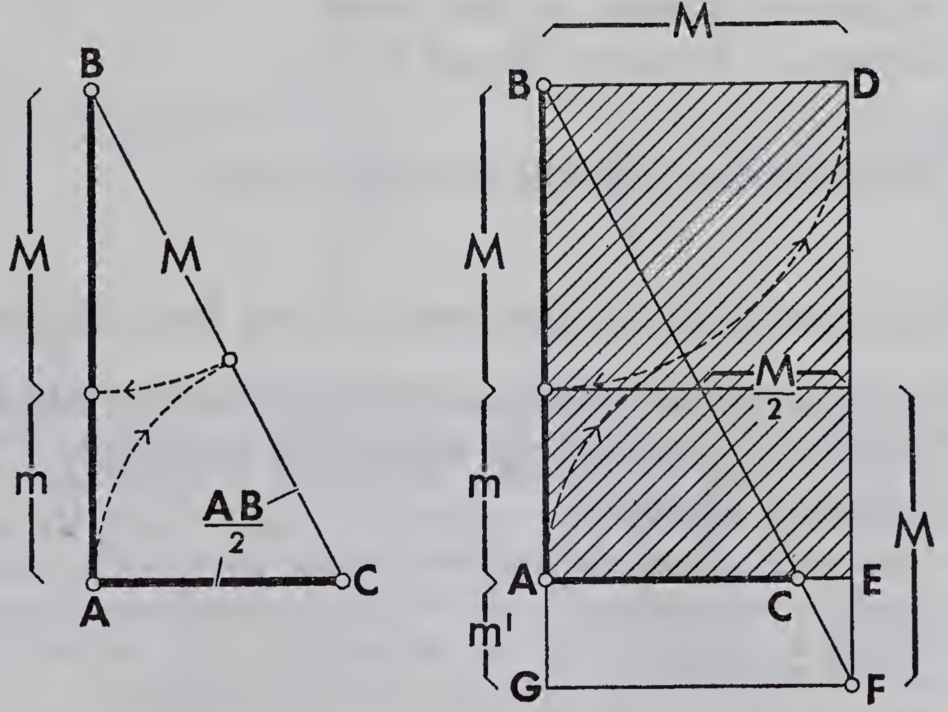
The Greek view of the totality of our experience of life, not a mechanical conglomeration of fragments but a purposeful design in which all the parts are interrelated, certainly took account of the laws of mathematics. 'He is unworthy of the name of man,' says Plato, 'who is ignorant of the fact that the diagonal of the square is incommensurable with its side.' If this sounds far-fetched to us it only underlines the paradox of our situation. In spite of the current emphasis on mathematics in education, most of us are still a very long way from being able to use mathematics as a key which will give us a broad understanding of both the living and the man-made world. Although we may entertain vague ideas that some of the new structures we see around us are moving closer to the perfection of the organic shapes of nature, we need a deeper understanding of mathematics as a whole. Such an understanding will extend our response to our environment.

Parts One and Two of Looking and Seeing have been concerned with discovering the relationships between the elements of our environment on the one hand and between this environment and ourselves on the other. Many of these elements are mathematical in essence. Buildings such as the Commonwealth Institute, 1, page 24, are able to express a greater range of mathematical laws than could buildings of the past. The same can be said of industrially produced objects. We must understand the basic laws which inspire these new forms if we are to appreciate them to the full.

Many of our engineers, architects, and designers reveal in their creations a great respect for the mathematical laws of the physical world. Because we are unfamiliar with these laws, and the almost emotional impact they make on designers, a full understanding of modern shapes often escapes us. It is not enough to understand the application of detailed mathematical principles to buildings and other objects. Before we examine the man-made world we must investigate the living world and discover the mathematical basis of its laws and relationships. If we then extend our investigations to the man-made world we shall find that the mathematical shapes of our great engineers, architects, and designers are in essence very close to natural shapes. This will help us to achieve a more complete experience of our environment.

pages 4-5 Mathematics affects our daily lives in many unconscious ways. When a batsman makes a stroke in a game of cricket his brain works out several ratios quite instinctively. His skill will to a large extent depend on the speed with which he can establish and react to mathematical proportions. When we arrange a number of objects on the mantelpiece our feeling for ratio and proportion comes into play.

In the strictest mathematical sense the term proportion implies an equality of ratios, e.g. $a : b = c : d$. This can be given visual form as in the Tempietto, 1, page 4, where the ratio of the height and width of the ground floor is the same as the ratio of the height and width of the first floor. This mathematical proportion is the root of the harmony of the building, so that when one ratio, i.e. one half of the proportion, is disturbed, the harmony and balance of the whole is also upset, **2**. But visual proportions are on the whole less precise than mathematical ones and the a: b = c: d formula cannot always be strictly applied. In a visual proportion the comparison of exact equality may be replaced by one which obeys the less strict rules of visual harmony. For instance, the architects and masons of medieval Europe devised numerous systems of relating measurements of buildings to each other. Each of these systems had an underlying mathematical diagram in which the measurements were related to each other mathematically through a set of harmonious ratios. Odd measurements which did not fit into the scale (and the comparison with a musical scale is apposite) were considered inharmonious and alien. Visual proportions as distinct from mathematical proportions can be described as comparisons of harmonious ratios which form a system of values. As a musician will select a small number of notes from the great number his ear can distinguish and build a whole work on these related notes, so an architect, if he wishes to achieve harmony, selects from the great mass of possible values a small number of related values.



To construct the Golden Section of AB draw $AC = \frac{AB}{2}$ *at right angles. With the point of the compasses at C draw an arc from A to intersect BC. With the compasses at B, draw an arc from this point to intersect AB in the ratio of ø. In the ø rectangle, shaded in the second diagram, other relationships are also indicated,* $M : m = m : m = ø$.

pages 5-9 The Golden Section and the Fibonacci series are two examples of mathematical relationships to be observed in natural shapes.

pages 10-12 The Modulor of Le Corbusier attempts to restate the idea of proportions based on mathematical relationships in terms of modern conditions and requirements. The individual measurements are related and give great flexibility in application. The grid derived from the Modulor gives an almost infinite number of possibilities of dividing surfaces in a harmonious way, which also makes prefabrication and standardisation possible.

The figures in the two columns above **2**, page 12, correspond to values in columns A and B respectively in **1**, page 10, but on page 12 each figure has been divided by ten and the decimal ignored. The value for C = 43 is derived from 432 in column A, that for E = 70 from 698 in column A, that of D = 53 from 534 in column B, and so on. Values from I to P do not actually appear in **1**, page 10, but can be worked out by continuing the Modulor series in the same ratio.

Diagrams **1** and **2** on page 12 show two different sections of the same building. The letters on the diagrams, which correspond with those in the two columns above **2**, indicate:

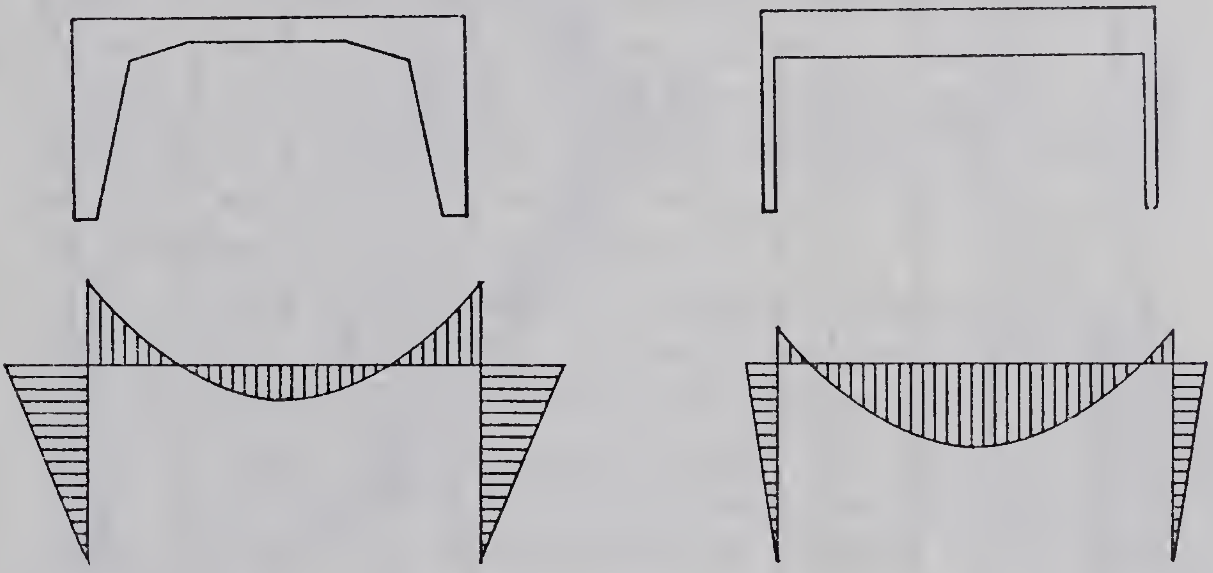
A	thickness of beam on the facade
B	difference between M and K
C	thicknesses of upright at various levels
D	
E	
F	distances between horizontals of top floor windows
G	
H	distance between left-hand edge of building and beginning of sun breaks (not marked in drawings)
I	height of windows
J	height of pilotis (pillars)
K	width of windows
L	depth of building
M	distance between pilotis
N	distances between uprights of wooden frames of top floor windows
P	

Several values are used more then once, e.g. D, E, F, G, I.

Further mathematical relationships are shown on page 13, *page 13*
but here the comparison is geometrical.

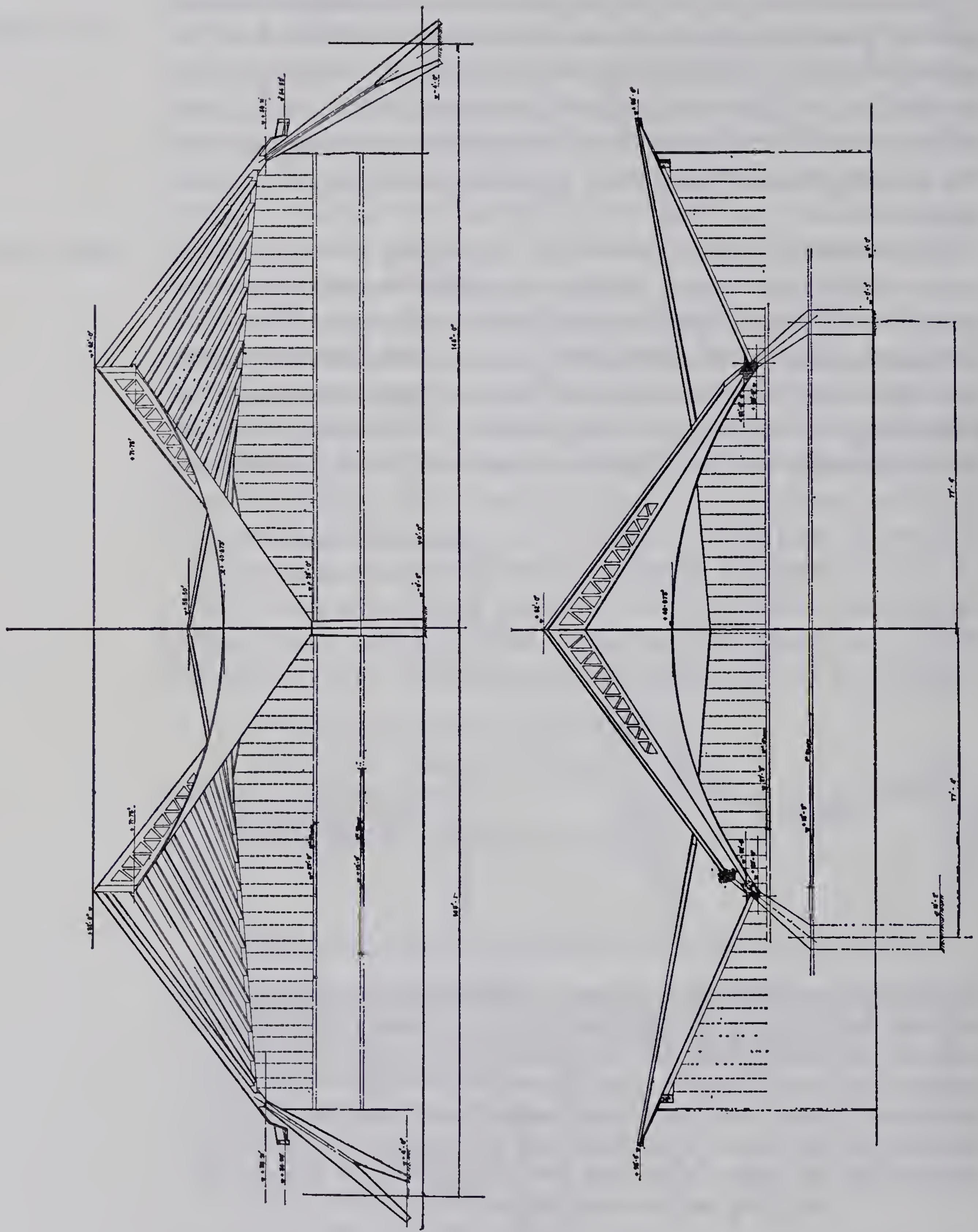
The four fishes, **10, 11, 13, 14,** are related to each other and their degree of relatedness can be shown to follow a set of co-ordinates. In **13** and **14** some of the co-ordinates are curved in a regular and logical distortion, but each fish can still be traced point by point. The fishes are: **10,** polyprion; **11,** pseudopriacanthus altus; **13,** scorpaena; **14,** antigonia capros.

The catenary curve (formed by a hanging chain or rope) *pages 14-16*
is one which is accepted without thought, but which can be shown to obey strict mathematical and mechanical laws. It is as though nature had calculated the most efficient curvature for a given set of circumstances. Because engineers calculate their shapes we must not imagine that these are automatic and that choice and initiative are irrelevant in their creation.



Each of the two bridges shown above is a calculated shape. Because of the different construction a different stress diagram (shaded) applies in each case. In the bridge on the left the greatest stress occurs at the corners, whereas the greatest stress in the bridge on the right occurs on the horizontal beam. In both cases the engineers may claim to have found a correct solution, for the shape is a justification of the diagram; yet the diagram results from the shape. Of the two, the lefthand bridge is visually more satisfying and more expressive of its function.

The engineer cannot calculate abstractions; he can only convert concrete intentions into definite mathematical structures. Before he starts to calculate he must have a basic



Two sectional drawings of the Commonwealth Institute.

idea and a conviction, based on mathematics, that this idea will work. Different engineers may approach the same problem in different ways and arrive at entirely different solutions, each of which may claim to be calculated and mathematical. It is in his choice of a solution that the engineer becomes an artist.

pages 17-19

The structures of Robert Maillart (1876-1940) were attacked by the more academic engineers of his period. To them the final shape was no more than an assembly of its parts. Maillart's structures are held together by an overriding basic idea to which all the smaller problems are related—the resultant shape cannot then be other than organic. The analysis on page 17 of Maillart's structural thought is far from complete. Further investigation uncovers layer upon layer of what one can only term structural wisdom and sensitivity. Although each problem is solved in a fashion which bears every mark of brilliance, the relationships between the parts, the whole, is never neglected. The difference between the work of a great engineer and a lesser one lies not in the accuracy of the calculations (Maillart was unusually bad at that) but in the assessment of the problem and the finding of an efficient answer. The work of any great creative artist may be described in those same terms.

pages 24-25

For a fuller realisation of a complex mathematical shape such as the roof structure of the Commonwealth Institute it is helpful to consult sectional drawings. The two reproduced on page 16 are taken through the two axes, i.e. at right angles to each other. They show the structure of this shape and how it is supported by interior and exterior buttresses.

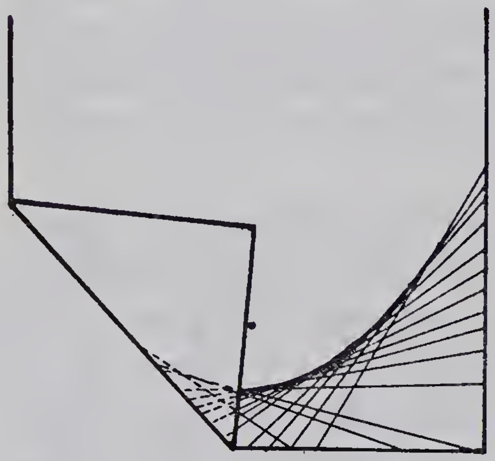
page 27

Mathematical models, such as those on show at the Science Museum, have a harmony like that of natural shapes. Turn them in any direction, like the pebble and the seashell in Part One, and a harmonious, related sequence of shapes will emerge. These models are used by mathematicians to help them in their understanding of the laws of mathematics. They may also be used for a different kind of understanding of spatial relationships between planes. Free adaptations, when used creatively, can do much to explain, as words certainly could not, the meaning of space.

pages 29-31

EXERCISES

Exercises in addition to those suggested could include the drawing of a parabola by successive folding of a piece of paper as shown in this diagram. Where the more accurate geometrical construction is not found too difficult more ambitious curves could be attempted like the one shown here. Pupils with special talents and interest in such work could take the exercises a stage further. For instance it should be possible to glue tissue paper or acetate (as used for lampshade making) to the wires describing a warped plane, thus giving it a feeling of solidity. The use of many different materials and colour (tissue paper and acetate are obtainable in many different shades) would further increase the scope and the fun. Existing mathematical (or near-mathematical) shapes could be incorporated in such structures, and gears, wheels and springs, especially if painted, should greatly add to them.



A parabola may be constructed by repeatedly folding a piece of paper in different places. The bottom edge must always be aligned with the same fixed point, equidistant from the sides of the paper.

Exercise 8 could start with an examination of the natural shapes mentioned in the chapter and then go on to suitable flowers, seed boxes, and seeds.

In exercise 9 it may be best to leave out all the values too small to be handled by pupils with ease.

The construction of a diagram of bending moments from the formula given on page 15 should also be carried out. The method is similar to that employed in the tracing of graphs, but the actual values selected must depend on the materials available, such as size of paper, accuracy of instruments, etc. It will be seen that the diagrams are not exactly translated into solid forms. Technological and other factors normally require a compromise, but the similarity between calculated shape and diagram is nevertheless striking.

The exercises are designed to lead the pupil step by step from the more severe forms of mathematical 'sculpture' to a free play and a sensuous realisation of similar laws. A person who has gone through this sequence of exercises in a constructive way, perhaps supplemented by further ones of his own devising, will be able to experience and not only 'understand', the complex structures of modern architecture. Not until we learn to see the creations of our industrial civilisation intellectually, sensuously, and emotionally shall we have created the right mental climate in which a truly modern architecture and design can flourish.

Chapter 2 Design for human beings

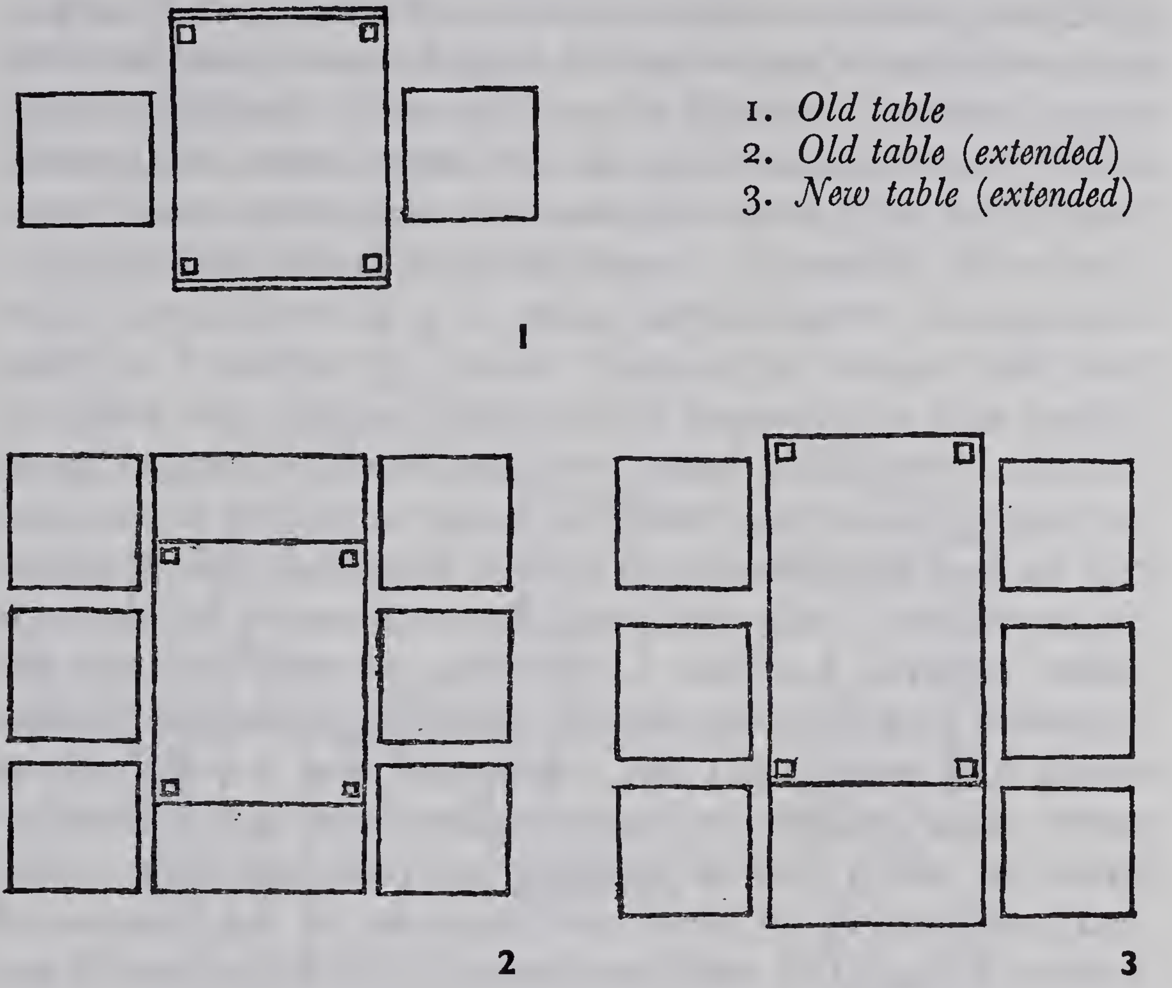
This includes the fitting of apparatus, furniture, buildings and towns to human needs. Scientific research is increasingly influencing design and brought into conflict with arbitrarily imposed styles.

Human Design answers the question 'Design for what?' It has many facets: ergonomics, communications, lettering, town planning. Ergonomics alone is an enormous field and covers not only the shaping and dimensioning of objects and buildings but also their colouring, lighting and heating. All these forms of design, and the research by which they are backed, deal with efficiency in human terms and in the last analysis this is the only efficiency that really matters. Industrial production and mechanical efficiency must be controlled in the human interest. This is the meaning of human design.

Too often machines were (and unfortunately still are) designed with reference only to themselves and human beings had to adapt themselves to the behaviour patterns demanded by the machines. Some machines, 5, page 33, apparently required even a changed human anatomy for efficient operation. Others, and this is largely outside the scope of this work, demand, by the same token, changed mental attitudes. That is why human design must concern itself not only with shapes and sizes of consumer goods but also with such remote aspects of our environment as the psychological effect of colours and surfaces and the effect of architecture on mental health.

All design has mathematical and mechanical aspects, and these must be directed to human ends. Ideally the mechanical and the human requirements should be fused so that we cannot tell where the one ends and the other begins.

Here is a simple yet telling example. Recently a Swedish furniture designer noticed that nearly all Swedish kitchen tables are made to the same size, 2 ft. 6 in. by 3 ft., with 1-ft. extension leaves at either end. Most of these tables are also used for eating. Because of the flaps, only two out of four people at the table could sit in comfort. When the table was fully extended to seat six people, four of them had to sit astride a table leg. This obviously did not make sense. The size was completely arbitrary and had little to do with the dimensions of the human body. So the designer re-planned the table and based the new version on his researches into people's needs and habits. The new table measured 2 ft. 6 in. by 4 ft., with an extension leaf of 1 ft. 7 in. at one end. This table easily seated four or even five people in comfort. When it was extended to accommodate six, no one had to sit opposite a leg. As the newly designed table has only one extension leaf it is actually cheaper to make. Like all clever solutions it looks much simpler on paper than it was to think out. But it shows how human design can make things better for all of us.



1. *Old table*
2. *Old table (extended)*
3. *New table (extended)*

We must not think that badly contrived designs can be put right by applying a few of the principles of human design to them. Normally neither human nor mechanical design can be substantially improved if the basic idea is wrong. Neither mechanical nor human design can be served by half-measures and afterthoughts. Both must spring from the same creativity. The analogy of the indivisibility of form and content of a work of art is not out of place here.

We often hear the word 're-design' and this turns out to be no more than a grudging concession to human beings, involving more expense and actually interfering with the manufacturer's idea of what a saleable product should look like. What is generally referred to as styling is sometimes regarded as a humanising influence on inhuman industrial products, but is in reality related to sales and not to function and usefulness. One industrial designer concerned with the design of motor cars told the present writer that if he were to take the recommendations of the Department of Scientific and Industrial Research seriously he would have to design a facia with differently shaped control knobs, but such an arrangement would impair sales. It is an ergonomic axiom that the function of controls should be reflected by their shapes, and so arranged that any one control can easily be located. Yet cars are being produced in which control knobs are unrelated to their function, neatly arranged in one long row so that identification is further impeded. Speedometers are notoriously badly designed. Rear mirrors in which shape (often quartic, i.e. like a television screen) but not the reflection have been considered, are all too common. Handles which look smart, but feel unpleasant and are difficult to move, chairs which are 'contemporary' but uncomfortable, streets in which lack of planning has produced disharmony and inefficiency, all these are examples of the absence of human design. The resulting human inefficiency cancels out any mechanical efficiency.

pages 32-33 Illustration 3, page 33, shows the controls of a locomotive still used in the 1940's. This construction was derived from a much earlier model produced at the height of the Industrial Revolution and basically unchanged since then. That this control panel was difficult to use cannot be in doubt; the dials are scattered, the controls far from ideal for the human hand. All this was aggravated by the picture of visual chaos with which the operator was confronted.

Illustration 5, page 33, is a diagram of the controls of a lathe in relation to the human anatomy. The upper diagram shows an average human being on the same scale. It is quite impossible to imagine that this machine was designed for use by ordinary people. The ideal person to operate it would have to be 4½ ft. tall, 2 ft. across the shoulders, and have an 8-ft.

arm-span. One may speculate how long the human organism would take to adjust itself to the conditions of this machine and evolve to produce beings which would satisfy the specifications implied by the design of this lathe!

pages 34-35

How mechanical and human design can combine and overlap in one object is demonstrated by the Ericsson telephone. The new version, **7**, **8**, page 35, was made possible by technological research which resulted in improvements to the mechanism. It is quite unimaginable that the human design was added to an existing mechanical design; the two must have been conceived at the same time and found expression in a common object.

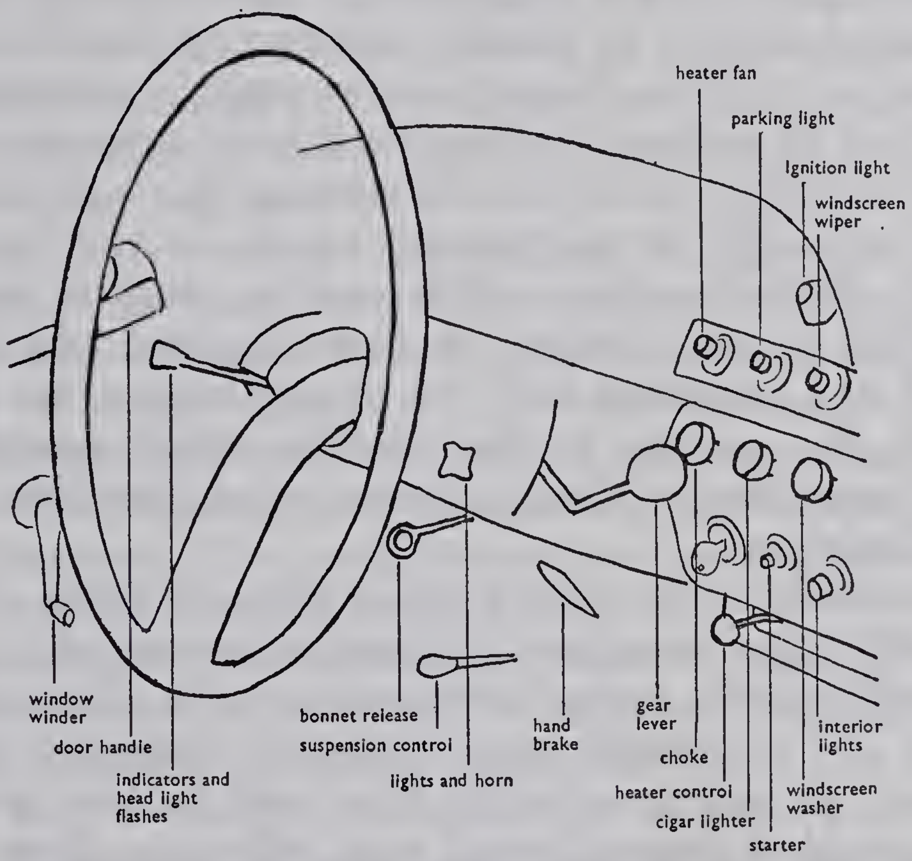


Diagram to explain the controls shown in 3, *page* 36.

pages 36-37

The wide field for human design will be evident from the illustrations on pages 36 and 37: from small controls designed to be operated by one's finger tips to the dentist's chair designed to receive the whole body. The many different handles and knobs of the motor car, **3**, page 36, should be studied in some detail, and compared to the functions they serve. Such shapes show that functional honesty with regard to human design not only makes them more pleasant and efficient to use but also to look at, and this is in itself one of the purposes of human design. The visual satisfaction derived from such objects is of a different order from that of merely 'styled' objects.

pages 38-39 The new crane cab, **3**, page 38, is a happier shape than the grim older one, **1**, **2**, but this is due not to a desire to improve its styling, or to create a novel shape, but to the hard facts of ergonomic research. The knobs, **5**, **6**, page 39, likewise betray their functions. The first three are intended for gradual turning and adjustment, the fourth as an on/off switch, the last two for turning into definite click positions. Too many controls on appliances, whether domestic or industrial, are still too haphazard. An examination of some of those which may be found in common use could form the basis of an exercise. Suggestions for possible improvements may lead to original designs. Additional functions which could be considered for such activities are knobs of levers, for sliding into different positions on a scale, and for push/pull actions. Plaster models, which can be roughly modelled according to one's feeling for their function, and further refined and smoothed after the plaster has set, are highly suitable for exercises of this kind, in which new designs should stem from tactile experience rather than from visual preconceptions.

The speedometers are not unique although many are now belatedly being re-designed. The quartic shape of **9** is quite indefensible and a serious interference with its efficiency. The figures are as though seen through a distorting mirror. Between 30 and 40 mph the hand will be lost against a background of figures, letters and calibration lines, while obscuring the milage recorder. **11** is also inefficient. The hand does not contrast sufficiently with the background. The reduction in the size of all the noughts does not help legibility. The reduction of the figure 4 in the middle of the scale is quite unwarranted. The lay-out of **10** is much clearer than either **9** or **11** but still has obvious drawbacks. The figures are not equally easy to read because of their varying angles; two of them are actually on their sides. The hand will cover any figure it points at, as well as, in certain positions, the trip recorder. **12** is a very good solution to these problems but one must feel that the partly transparent hand (to make the trip recorder visible in all positions) is not the ultimate answer because it has another inherent drawback: reduction in the hand's length. However, looking at the 4 dials together, **12** is by far the most satisfying from the functional and visual points of view.

pages 40-41

The new lathe, page 41, has its main controls grouped in the middle within easy reach; those which control the *adjustment* of the machine are placed on a black background, clearly differentiated from those which control the *operation*, placed on a yellow background. This differentiation is supported by the colour division of the whole body which breaks away from the uniformly painted older model in which the different parts are not articulated. **3** and **4** show the fine ergonomic detailing which matches in every respect the mechanical detailing. The function of each part is individually expressed but an overriding thought-pattern on the part of the designer has welded them into a harmonious pattern such as we have discussed in Part One. This is particularly noticeable in **4**. The older form of this machine might have been considered efficient by most people, even from the point of view of human design. **5** shows that by visual means increased efficiency could be achieved. Each part has been given a visual meaning and the whole machine has acquired a visual harmony. The smallest items have been related to the whole, even the name of the model.

pages 42-43

The controls of the ship's engine room, **1**, page 42, were presumably manufactured by the makers of the different pieces of equipment and are completely unrelated. The visual muddle makes checking and operating difficult. In the new version, **3**, the controls have been grouped in a harmonious whole. Some dials have been replaced with warning lights. The whole design is improved. Only the clock face (extreme right), with its Roman figures, seems to have been overlooked by the designer.

Thanks to technological progress the levers of the old signal box, **2**, have been abolished in the new design, **4**. The diagram in **2** is an almost exact replica of the actual layout of points and lines. In **4** the diagram is an abstraction of the exact topography which facilitates visual communication. The diagram is part of the mechanism itself and not merely an explanation of it. Graphic design is here a facet of human design; we shall deal with it in greater detail in the next chapter. But in spite of its increased efficiency there are still two flaws in the new signal box. No stool has been designed for it and the old one (obviously rescued from the previous signal box) is too unrelated to the new panel to give the operator any real comfort. Also, the top panel seems to reflect too much light so that parts of the diagram become unreadable. (This is the answer to exercise 4, page 58.)

pages 44-45 Design procedures which probe deeply into the user's requirements should be applied to every object.

When the London County Council decided to design a full range of school furniture, it looked first of all into the question of the measurements and habits of school children of different ages. This was quite a long drawn-out and arduous task and involved setting up various contrivances to get as close as possible to the right answer. Much of this work was done by placing a screen behind a chair and desk and a strong light source in front of it. Many children were then asked to sit at this desk in turn, to move and behave as they normally would in class, and to get up again. Their movements and dimensions were projected onto the screen, where they were recorded photographically. The drawing, 1, page 44, was based on this research. The designer of the furniture then had the task of using the information summarised in this diagram in a design which could be produced at a reasonable price. The current range of LCC school furniture has set a high standard because of the thoroughness of its approach to design.

In the past the building of a house was the province of one man who could design and supervise the whole project. Now architects have to assimilate not only the many different techniques of building (from structure to decoration) but also the many different needs which are constantly arising. Where in the past the architect could often indulge the luxury of choosing a style, the best present-day architects consider human measurements and behaviour and requirements of light and air and consult complicated graphs indicating the type of heating the human body requires under certain conditions. Eventually it may be possible for all buildings to be designed in the same way as St. Anne's College, Oxford, in which everything from the lamps in the rooms to the siting of the building has been considered. But we must bear in mind that because of the architect's understanding of the setting of the new complex, he has been able to use prefabricated elements to their best advantage. Oxford's buildings have very strong modelling, with many accents and contrasts of light and shade. Modern buildings like this one continue this overall pattern. Modern techniques have here been used to express the function of the new buildings. At the same time they are in harmony with the spirit of the place.

Note Observant readers will notice the apparent discrepancy between the photograph of the model room, **5**, and the plan, **4**, and the photograph of the exterior of the building, **6**. This is accounted for by the fact that **5** shows a ground floor room at the back of the building, not visible in **6**, and the plan, **4**, is of an upper storey. As **4** shows, each room is reached through a lobby, separated from the room itself by a sliding door.

pages 46-47

Mass production makes the problem of human design specially acute, yet still not enough manufacturers pay adequate attention to human needs. The gas cooker in 1, page 46, had to be raised to bring it up to the level of the working surface. The great advantage of this method of building-in ready-assembled domestic equipment is not only economic; it also prevents small local builders with little knowledge of or interest in human design from committing blunders from which generations of occupants will have to suffer. Yet in spite of the great concern for human design by the architectural profession many manufacturers of prefabricated parts used in building still show a fine disregard for the principles of human design. A recent survey of industrialised building states bluntly: '. . . reference is made to efficient laboratory tests and studies of production techniques. . . . There has been no mention of user requirement studies. . . .' But even if such studies were carried out they might be anulled by other interests. 'Where the product is transported there were some ingeniously logical modifications to the product. In one case the heart unit dimensions were slightly altered to enable three to fit on a standard lorry, in another the wall panel was clipped by three inches to allow it to fit within the width allowed for road transport without a licence.' This sounds ominous. Many examples of human design mentioned in Part Three are still the exception rather than the rule; most of the best efforts are produced in very small numbers, sometimes only in ones. At the same time large numbers of mass-produced objects and buildings are put on the market which are often highly efficient and clever in many respects but ignore many requirements of human design. Rarely do hospitals reach the high standard of the one in Greenock, page 47.

pages 48-51 British Railways have started on a vast programme of modernisation based on user requirement studies. Many of the new designs have great merit and point the way to better things still to come. The totality of design is recognised and the programme is comprehensive. Some of it is concerned with comfort, much of it with safety, but there is no appreciable difference between these two aspects of human design, and often they coincide. For instance the new door, **4**, page 51, which gives better access to the coach and makes a spacious lobby possible is also safer. The portion of the door still projecting after the greater part of it has slid into the coach would still clear a passing train. That letter design also contains a safety factor can be seen by pictures **6** and **7**, page 51. Note how much clearer the new letters are when seen from a distance. The diagram, **8**, showing how letters may be spaced (the lines indicate the spaces to be allowed, depending on the following letter) demonstrates the careful attention to details.

pages 52-55 The design of towns is perhaps the greatest challenge to human design. Past ages took this branch of design very seriously and this is amply testified by old towns where the evidence has not yet been swept away. Part Four will deal with this at length but let us make a few basic observations. The design of individual objects, street furniture and buildings does not add up to town design. Often excellently designed buildings are badly sited or surrounded by so much that is inferior that their qualities are lost. Town design—or town planning—has as its object the creation of humane conditions on the largest scale: townscape. This is, because of its enormous scope, difficult to define with any accuracy but a recent re-statement in the *Architectural Review* comes fairly close to it. 'Townscape . . . is simply the visible expression of collective life—not collectivised life—man growing together to make a higher organism, enhancing rather than destroying the individual lives comprised within it. . . . freedom (is) given back as a consequence of submission to a place . . . it is pretty far from architectural self-expression . . . *it is the only thing that will engage man's whole activity.*' It is clear that something more than detailed planning is needed, yet planning and research must form the backbone of it.

It is strange to think that workers operating efficient, scientific machinery in factories and offices, 1, page 52, are faced by the most unscientific conditions as soon as they leave their places of work. The different functions of the town are not in any way defined or given scope to work smoothly. The old idea of a central roadway with lateral sidewalks, devised for conditions different from our own, has been patched up to serve our age. Even where war damage and redevelopment brought about conditions for a new creative approach to this problem civic reasoning had hardened into definite grooves from which it was difficult to dislodge it, This is another hangover from the nineteenth century when most creative energies in civic design were dissipated in completely irrelevant pursuits (e.g. the battle of the styles) instead of coming to grips with the real problems.

The new towns and the redevelopments of older ones are attempts to build mechanisms which will deal with the pressures of present-day living and re-create in their citizens a measure of civic pride and a share of the responsibility for their environment. Nobody could assert that this is easy or that many mistakes have not been made. For instance, in trying to give people more living space planners have often created wide, bleak, draughty-looking spaces which, coupled with the unfamiliarity of the new surroundings, have caused a certain amount of depression in some people. A higher density of people is now thought to be more desirable. Too much designing was probably done by planners rather than by architects, i.e. in two rather than three dimensions. Attention was paid to graphs, but too often these were interpreted without enough reference to the psychology of the individual. Slowly these shortcomings are being remedied —by paying more attention to emotional efficiency. (See the Introduction to Notes for Teachers Part One.)

pages 56-57 These pages show how the function of quite ordinary objects may be interpreted visually in terms of human design. The over-elaboration of 2 and 3 contrasts most tellingly with, say, **6** and 4, which were intended for similar purposes. 2 and 3 create delusions of vague concepts such as 'artistic craftsmanship' or 'design'; 1 is trying to give an impression of purposeful design. The designs on page 57 are good ones because the designers' first consideration was the needs of the users. 4 is a hard-working lamp, while 3 could be described as a parasite. Good shapes are produced as a result of and not in spite of human design.

page 58 EXERCISES

The exercises reinforce the notion that in good design material is related to function and where applicable to human function. The light switch, 1, is more easily operated than the older type in which a small lever has to be pushed up or down—it is also more graceful and pleasing to the touch. In this simple object the principle of human design is clearly demonstrated. Examination of common objects, both simple and complicated, should increase an awareness of the importance of human design. A pair of pliers must be designed to fit the human hand and to perform its mechanical function efficiently. Pupils should examine a number of different models and decide how well designed they are from both points of view. This lesson can be applied to machines, such as bicycles and sewing machines. In each case drawings should, as usual, accompany the answers. Good points should be explained, improvements suggested. Furniture can then be subjected to an enquiry of the same kind. Visual points should be taken, 'styling' or even 'over-styling' criticised, especially where it conflicts with the interests of human design. It would be a good idea to ask pupils to imagine they are buying the object in question. A game could be devised in which one pupil takes the part of the salesman trying to sell the commodity, while another pupil takes the part of the customer. Both good and bad designs should be 'sold'. Where poor design is in question, the 'salesman' will seize on any point which he thinks will make the object less undesirable, even making capital out of disadvantages (e.g. cars with only two doors are 'child-proof'). To think the thoughts of the salesman whose job it is to sell, even to sell badly designed objects, will help develop awareness of the problems involved in human design. Acting the part of the unwilling buyer will have a similar effect. Of the two, the salesman's part is the more exacting and requires a great deal of mental flexibility; a bright pupil should be selected for it: one who understands not only the principles involved but also their opposites. Alternatively the teacher should take the part. The class, having witnessed the proceedings, should show satisfaction or dissatisfaction with the product.

The old dial, **5**, in exercise 5, has many common faults: indistinct and tilted figures (the last one actually upside down), divisions which do not indicate at a glance the value shown, an insufficiently conspicuous hand. **6** is an enormous improvement, but something has had to be sacrificed. In an attempt to make the arc as large as possible and the divisions wider, the figures have been placed inside the circumference where they will at times become obscured by the pointer. But in view of the simplicity of the scale this is a minor criticism. The three sets of figures, exercise 7, are taken from dials which were actually produced. **2** was designed for maximum legibility and distinction; it is somewhat ungainly and clumsy. **3** is a 'styled' set of figures which can easily lead to misreadings; notice especially the similarity between 8 and 0. **4** was designed to be both legible and harmonious. It still has certain weaknesses, which become apparent upon comparison with Kinnear's road sign figures, **2**, page 59, and **11**, page 62 (notice in particular the differences between the two designs for 8 and 9), but it is much superior to the other two. Exercise 8 sums up the graphic design part of human design and leads to the next chapter in which graphic design is defined as a means of communication.

Chapter 3 Visual communications

Graphic design, i.e. signs, symbols, posters, books, considered from the point of view of human design. Function here is the communication of thoughts and ideas in the most efficient form.

pages 59-63 Graphic design must be considered as an aspect of human design because it is used as a means of conveying information to human beings. Its task is to convey information clearly and to create a harmonious pattern in the mind of the onlooker which will reinforce the message. The designer of a book jacket and of a road sign face what is in essence the same problem: both are concerned with putting over a message in visual terms, both are dealing in visual communication. They may deliver different messages, one may be wholly addressed to the reason, the other to the emotions, or, more usually, to a mixture of both. Their messages may also be designed to be absorbed in different states of mind. These and other factors account for the different terms in which they are couched, but both may be judged by similar standards of efficiency. This efficiency will increase with the designer's skill in handling his raw material and exploiting it to the full and his work can therefore be compared to the potter's, or the architect's. He uses his materials and the processes of graphic reproduction to put before us visual symbols which carry out his purpose. He must choose the most efficient symbols. A certain set of pictorial symbols may be the best vehicle for a road safety message which would be quite ineffectual if printed in type on a plain background. The instructions for the use of a machine, on the other hand, may be made almost incomprehensible if the designer chooses a pictorial treatment for them.

It is not often realised that the design of road signs, **5-9**, page 62, constitutes the creation of a visual code. These visual symbols denote different ideas and must therefore be given sufficient distinction to make their differences easily discernible while at the same time retaining a family resemblance which will set them apart from other types of sign. This, in view of the increasing tendency to crowd streets with more and yet more signs of every description, is of the greatest importance. Road signs must also be capable of being joined in groups of two or more to form coherent visual sentences. It may be a good idea to get hold of a copy of the Report of the Warboys Committee for a discussion of the new road signs, comparing them to the old. Discussion should centre on clarity (legibility), an appraisal of the actual shapes (compare the new arrow to the old), certain ambiguities still present ('road narrows' and 'end of dual carriageway') and finally on the question whether the new signs as a group give us a more logical and efficient language. The absence of such a language leads to inefficiency, **1**, page 60. The prohibition sign is swallowed up by the chaotic street picture. Apart from forming a disharmonious pattern, the shop signs, **2**, **3**, **4**, are difficult to read. Visual communications must be considered a part of the townscape. Our architecture, road planning and town planning cannot become fully effective so long as bad visual communications are allowed to mar their purpose. The argument of self-expression is irrelevant. Unrestrained self-expression if selfishly used may create conditions unfavourable to human beings. Some kind of self-restraint for the common good must be an accepted practice in any town where the people respect their surroundings.

The examples on pages 62 and 63 show that simple good manners and a willingness to come to terms with society and not to exploit it for one's own ends will create civilised streets and still leave enough scope for individuality. The signs, **12-14**, on page 62 are clear and have the necessary family resemblance. It is possible to be prosecuted for making too much noise in public, why then should **7**, page 61, be tolerated?

pages 64-72

In a well-designed book type and illustrations are related. How this was achieved in early printed books can be seen in pictures **1** and **2**, page 64. In each the character of the type is matched by the drawing. The advent of mechanical processes of reproduction did away with many of the craft processes, as has happened in many other industries, and by and large printers lost their feeling for relating type and illustrations. **3**, a product of more recent times, shows this. Look at the different widths of the type area and the meaningless overlapping of pictures, which place an unnecessary burden on the reader. 5, page 65, on the other hand, is an efficient piece of book design. The pictures are presented in a clear manner; the type width is the same throughout and the type face is easy to read; the relative masses of text and pictures are balanced and composed. Judged purely from the point of view of visual communication, 5 is an efficient mechanism, while 3 is not.

The three book openings on page 66 are outstanding examples of how even scientific subject matter can be illustrated in a way which does not merely repeat what the text has already stated, but makes its own special contribution. In each case the illustrator has gone beyond mere factual illustration. These books have the unique distinction of having been conceived and designed by their illustrators, the text being written to fit the overall plan. This is a reversal of the usual procedure and the result suggests that it might be employed more frequently. Scientists are sometimes not very good at communicating their ideas, while graphic designers should be experts in this field. In the words of the publisher, the artist has here 'been invited to disseminate scientific information, just as his medieval predecessor disseminated religious information.'

The place of graphic design in visual communication is further illustrated and developed on the following pages of the pupils' book.

page 73

EXERCISES

Exercises 4 and 5 should be carried out with great care and as many samples as possible should be collected and exhibited. Illustration 4, page 73, is typical of many trade catalogues which are difficult to use because of their ill-considered layout. Note that many different types are used for the headings. The letterhead, 5, is another example of inefficient design; it is difficult to find any definite information without hunting for it. Exercise 5 could be carried out in teams and should be supported by photographs or drawings.

Chapter 4 What is a visual language?

The shared character of contemporary things, produced by the mental climate of a period. When new ideas and new ways of thinking make the old visual language inefficient, a new one is devised.

The first three chapters of Part Three discussed the various influences which contribute to the formation of the man-made environment. There are standards by which all man-made things of whatever period should be judged: an understanding of the basic laws of harmony, of proportion, and of balance, a sympathy with the character of materials, and a sense of what is appropriate for a given purpose.

We have already observed in Part Two that certain pressures and forces exert a subtle influence on the man-made environment (churches, pages 53-59, Part Two; chairs, pages 60-61, Part Two) and these also should be taken into consideration when examining the products of different periods. In fact, religion, economics, politics, philosophy, landscape, climate, and traditional background all contribute to the creation of human environments. Together they set the scene and supply a scale of values for the whole assembly of man-made objects which comprises the environment of each succeeding generation. If the same influences affect all products of a given environment at a given period, these products will have some common quality which unites them and at the same time distinguishes them from those of other periods. This is what Le Corbusier defines as a style: 'a unity of principle animating all the work of an epoch'; but to most people the word has quite a different meaning, implying a manner chosen at will. The expression 'visual language' comes much closer to defining the visual expression of Le Corbusier's 'unity of principle', a set of values which are accepted by each individual and which give the products of a whole period their special character.

We can now see the Gothic style as a solution to various, often opposing, demands. Structural and aesthetic problems of the period were discussed on pages 53-59 of Part Two, where we read how these were made more acute by certain social and economic pressures. Building materials were dearer, while at the same time larger churches were required to accommodate the growing congregations of growing towns. The desire to build high churches stemmed not only from religious feeling but also from the political and social needs of the towns with their increasing affluence. The church chimes not only summoned the townspeople to services and prayer, but also gave a background to their lives, a scale against which the activities of the town could be measured. Since the activities of the surrounding country had to follow the same pattern of timing (e.g. market-time, curfew, etc.) it was advantageous to build the bell tower as high as possible so that its chimes would be heard far afield. Church spires soared not only heavenwards but also skywards.

When the cathedral of Chartres was burned down early in the twelfth century it was felt not only as a great material loss, but also as a punishment and a tragedy. When a certain event was interpreted as a sign from God to rebuild the cathedral the whole population of the town took part in this enormous task. We may find it difficult today to imagine that such a huge building, where every inhabitant could be accommodated at one service, was put up by a population numbering no more than 6,000. When the people of Chartres entered their completed new cathedral for the first time, they could have been in no doubt that this was the only right way of building a cathedral; it satisfied every demand, social as well as liturgical. It flattered their local pride and their religious aspirations, and they knew that the most modern and advanced methods had been employed to construct it. It was the perfect expression of their thoughts and feelings.

Gothic is a long period, which drew its strength at one end from the Romanesque and fed the Renaissance at the other. Gothic may then be seen as partly medieval and partly initiating a new view of the world which proved to be the downfall of medievalism. Social and political changes ran parallel with these developments and will be discussed more fully in Part Four.

The description on page 77 is not intended to be an accurate or complete description of an artistic process, but it shows one aspect in simplified form and so long as this is borne in mind it can serve as a useful symbol. The events in the life of the artist, and also his relationship with the community, are not necessarily remembered or even recreated by him, but, just as in the case of our hypothetical artist, they influence his work in a way which, although he may not suspect it, often sets up a conflict within him. In self-defence he unconsciously seeks to reconcile this outer reality with his own desires and needs. In order to do so he gropes for new methods appropriate to changing conditions.

The visual arts of any period can be understood only through a knowledge of its visual language. It is the common ingredient in all that man makes during any one period, and because such a language brings the different elements of the human environment together it has a harmonising influence on the patterns which surround mankind. Its influence is twofold: between man and his environment and between the elements of the environment.

The purpose of this chapter is not so much to give a historical survey of different visual languages—something like it will be attempted in Part Four—but to explain the idea and origin of any visual language, so that we may then apply the same broad principles to our own time. Visual language has nothing to do with taste or what is popularly known as style, it is the visual means evolved by a period to bring together the thoughts and feelings by which people are dominated at that time (the mental climate) and to relate them to the technology and state of society of the time. It is a means of coming to terms with life, and of building an environment in keeping with human needs. The calculated shapes of chapter 1, the ergonomic shapes of chapter 2, the means of communication discussed in chapter 3 cannot be considered in isolation from each other and from other developments. Our visual language is the connecting link.

How strongly the vision of an age is dominated by its own particular values is shown by illustrations 2 and 3 on page 75. The relationships between people and between people and buildings is given a different form from what we would accept today. But the medieval mind considered this representation of the living world as adequate and true. The size of an object is derived from its importance and not from its position in space in relation to the observer.

The harmony between the constituent elements of any visual language can be recognised even in the smallest details. Stained glass is a case in point. Stained glass windows made their first real contribution to architecture when walls ceased to be loadbearing and could be made to accommodate vast expanses of glass. Coloured light fulfilled a definite purpose in the scheme of a medieval church. Abbot Suger, the founder of St Denis, was perhaps the first to describe its effect when he spoke of the deep religious experience he received from the vision of a shaft of light playing on the altar of his church. Coloured light was an organic part of the medieval church and enhanced the emotional character of the architecture so that there was no doubt in the mind of each member of the congregation that he was in the house of God and removed from everyday experience. The technique of assembling pieces of glass in one large design was itself conducive to the non-naturalistic effect to which medieval art aspired. In every respect stained glass belonged to the medieval tradition. The church architecture of later periods did not employ light in this way. The Renaissance church, for instance, is more of this world than its medieval counterpart and the light, even if subdued, must always be clear, for coloured light would destroy the feeling of space. Just as stained glass windows were contrary to the spirit of Renaissance architecture so the technique of stained glass was equally opposed to the more highly modelled representation of people and of nature demanded by the mental climate of the Renaissance. In post-medieval stained glass there is a conflict between the heavy lines of the leading which seem to demand a flat treatment and the attempted roundness of figures and objects which seems to oppose the demands of the material. The fusion of technology and of spiritual values which in this case was peculiar to medievalism could not be translated piecemeal into another visual language.

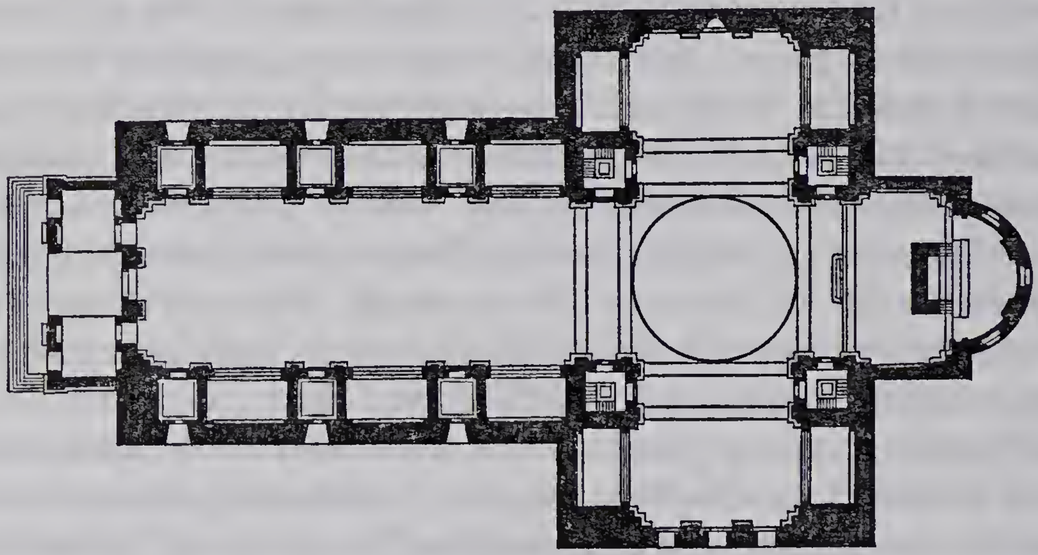
The objects shown on pages 78 and 79 are one way of illustrating the medieval visual language, others could no doubt be devised. Although not all the items are contemporary, they represent in different forms and at different times a tendency which can be observed throughout the period.

The following pages of the pupils' book show how the medieval visual language changed to that of the Renaissance. Only in Italy, and more particularly in North Italy, could the Renaissance have thrived. To say that 'Italy anticipated the classicism of the Renaissance just as it anticipated the capitalistic development of the West with its economic rationalism' is to put the whole thing in a nutshell. Feudalism had never developed as it had in Northern European countries, and the Italian aristocrat, as he emerged from the Middle Ages, adapted himself readily to the new commercial conditions. The physical remains of classical antiquity in Italy must have kept alive throughout the medieval period a feeling for classical architecture—Roman buildings were actually still in use at the beginning of the Renaissance—while the principles of Gothic architecture had never been properly understood.

But this does not wholly explain the advent of the Renaissance. Had there been no Classicism to draw on and to borrow from Italy would still have produced a Renaissance. The real clue must be sought in the essentially pagan character of the Italian people. Theology was not generally taught at Italian universities at a time when it was the most important subject at Northern European universities. On the other hand the study of law—the ordering of the material world—took precedence at Italian universities. Italy had no important theologians during the Middle Ages and such as there were had studied abroad. This attitude has its visual expression in the layout of the average Italian village and town where the church seldom has the prominent, overpowering position given to it in Northern Europe. Often the campanile stands separate from the church—a symbol of civic rather than religious dignity. Burckhardt has pointed out that even their prayers combined much of the materialism of antiquity with the ideas of Christian morality—a typical Italian compromise which seems to obtain the best of both worlds.

The Italian feeling for spatial relationships, which resulted from their acute sense of the physical world, accounts for their town-planning ability. The disposition of open spaces and solid masses in the average North Italian town or even in the interior of Italian houses of the early Renaissance indicates a different approach to the man-made world from that of the Northern European. The inborn qualities of the Italian people were strengthened by the political conditions of the period. The North European organisation of society, based on small independent townships and exemplified by the Gothic cathedral, gave way to the centralised systems of Italian despotisms.

The centralised plan of a church is not an invention of the Renaissance but during this period it assumed a special significance. In a centralised church the observer is, by the disposition of architectural spaces, encouraged to place himself in the centre in order to obtain the most perfect view of the building. The significance of this in an age of humanism need hardly be stressed. Alberti's church of St Andrea in Mantua, 1 and 2, page 86, arrives at a compromise between the new humanistic forces and liturgical function: it is cruciform with a strong central emphasis. The ground plan shows a strong feeling for one continuous space, unlike the Gothic cathedral which is broken up into nave, aisles and transept and further subdivided by numerous vaults.



Side chapels are never detached from the main mass, but form part of one continuous space. There is not a single pillar to disturb the continuity and unity of the architectural space, while the strict application of mathematical proportions gives this church a harmonious pattern. In the same way as the architectural patterns of the medieval church seemed to follow the thought-patterns of its period and in particular those of the 'summa' (medieval treatise), 1, page 76, so the architectural patterns of the Renaissance church corresponded to the predominant thought-patterns of the Renaissance.

EXERCISES

pages 88-90

This chapter has described in broad outline the most salient features of two different visual languages, and the reasons which led from the one to the other. That the distinction between the two was never complete, that there were overlappings and anachronisms can be seen from such buildings as the Henry VII chapel, **1**, page 90, which was completed in the sixteenth century and combines features of the Gothic and the Renaissance. The strong horizontality, as opposed to the verticality of true Gothic, and the domed pinnacles especially mark it as a work already far removed from the medieval spirit. Palladio's drawing, **2**, was made in the same century—it shows the common interest of Renaissance artists and architects (compare it with **2**, page 84).

It should now be possible to encourage pupils to place buildings, objects and paintings between the eleventh and sixteenth centuries in their approximate historical periods, or to arrange a number of them in their historical sequence. Picture postcards from museums of subjects similar to those on pages 75, 78—90 might provide the raw material for a game of detection. Pupils should give the reasons for their guesses and point out the clues which they consider significant.

Chapter 5 The visual language of our own times

A brief history of the modern movement in architecture, design and art. How the mental preoccupations and the technological advances of our time have combined to give us a visual language which should serve us to express ourselves and to create human and harmonious environments.

pages 91-93 Until the end of the nineteenth century scientific knowledge was limited to a consideration of purely physical phenomena. But with the advent of the twentieth century and the spate of discoveries then made man somehow manage to get under the skin of nature. The old system of thought was found to be wholly unsatisfactory under the newly discovered conditions. Things were no longer what they had seemed to be, and the old fabric of beliefs crumbled. During the era of the Curies, Einstein and Freud our understanding of the properties and appearance of nature, our whole system of thought underwent what were probably the most violent and momentous changes ever experienced.

Artists, although much more cut off from scientific developments than the artists of the Renaissance, were still conscious of scientific research. Like the scientists, they reached a turning point: the breakthrough which led to the discovery of a less obvious but more profound reality than that of naturalism. Both artists and scientists were living in the same mental climate and exploring beneath the surface.

The word *analysis* is used in this chapter for the first time. It denotes a new kind of investigation demanded by the new state of knowledge: an examination in depth, precise, cold and unimpassioned. It is the tool of both art and science.

The second half of the nineteenth century was on the whole a smug period. Scientists had made enormous strides in their discoveries of the physical aspects of nature. They thought they had almost reached the end of the road. Just about everything could be explained in terms of the then accepted laws of science. Nature could be understood by those who knew its simple and tidy rules. A high official of the US Patents Office resigned his position because he saw no future in patents, everything of any consequence had already been invented and patented. The steam engine was the source of seemingly unlimited power, not only for the new, thriving industries which turned out plentiful, cheap mass-produced goods but also for cheap transport of those same goods, and of course for travel. Electricity could be made to perform apparent miracles. To many of that period—at least to members of the middle class—life must have seemed good. Man felt very much in command. There were still loose ends to be tied up, but nature was all but conquered.

The art of the the period—that is to say the official art, the art of the salons—has the same self-satisfied character. Tissot's painting of the 'Gallery of HMS Calcutta', 1, page 92, is quite typical. It is of course a very charming picture indeed. The painter has placed the dark mass of the sailor's body behind the lady on the left so that her graceful outline should be heightened. On the other hand, her head with its predominantly dark accents of hat, ribbon, hair, eyes and eyebrows is silhouetted against the light coloured ceiling boards. She is the central character of the painting; her companion and the sailor lean forward in parallel motions but her body has sprung back in a delightful counter-movement balancing the other two. The slightly disarrayed line of chairs gives the whole painting a sense of depth; you will see how much it contributes to the composition and the final effect of the painting if you cover the chairs with your hand and look at what remains. The feeling of space and air will have almost entirely disappeared. The painter, through his obvious great pictorial knowledge and the evident skill with which he manipulated it felt as much in command as his scientific brethren. This was indeed the end and the summit; further developments were difficult to contemplate. Although everything in this picture is painted with a real sense of delight, the idea of smugness cannot be dissociated from it.

This self-satisfied and cosy world had already received its first jolts with the discovery of the atom, but on the whole the defences had held. However, further attacks by successive scientists which culminated in the work of the Curies and the realisation that matter and energy are one and the same thing hastened the demise of the old ways of thinking and seeing. Art—the interpreter, the balancing rod—would have had to follow these developments in any case, and indeed did; but there were other equally important developments peculiar to art itself and which were the outcome of analytical attitudes similar to those of the scientists. The situation was a complicated one with many intertwining actions and reactions but scientists and artists can be said to have pursued parallel paths in which they often influenced each other.

Impressionism was the first crack in the nineteenth-century structure of realism. It has often been described as 'mere' scientific painting (Gauguin called the Impressionists 'those little green chemists'), but this is to confuse cause and effect. The Impressionists undoubtedly used the scientific ideas of their day relating to light (in essence they go back to the ideas advanced by Leonardo da Vinci), but they used this method of painting in order to express the new mental climate which was developing at that time. Impressionism is a movement towards visual re-integration. A picture of a tree with myriads of painstakingly painted leaves is not necessarily a portrait of a living tree but simply of a number of leaves. Impressionism tried to recreate the totality of the visual world. Pissarro's painting, **2**, **3**, page 93, does not depict a series of objects brought together by chance but an impression of a total visual reality. The Impressionists achieved this by examining not only the behaviour of light, but also its composition. They were influenced by the new understanding of the nature of change and movement. In their new method they had a fairly efficient tool for catching the most fleeting moods of nature. Monet's painting of St Lazare Station seems to arrest one moment out of a long sequence and we are made acutely aware of this. The visual concept of a haystack at seven o'clock in the morning is entirely different from that at three o'clock in the afternoon; therefore, in order to give a true visual record of a haystack a whole series of paintings was required and not just one.

Impressionism was a scientific art movement in quite another sense. It provided a way out of the sentimental quagmire of the nineteenth century. By their analytical methods the Impressionists set out to produce an undistorted view of the world. Impressionism was a kind of visual research in the best tradition. The artist sent out a number of highly photosensitive lines of communication into the world.

The messages they sent back served the artist as the raw material for his work. The artist was no longer to be the hero, his emotions had been found to be unreliable; he was to retire behind his work 'paring his finger nails'. Instead, light itself, the conveyor of visual truth, became of prime importance.

pages 94-95 Paul Cézanne went even further than the Impressionists in his analysis of the visual world. For him form, rather than light, was of supreme importance. He had no thoughts of starting a new modern movement but only of continuing the work of the old masters and in particular 'to do Poussin again from nature'. He wanted to discover the structure of the world as it really exists in its own right, and not as it is found in the imagination of human beings, distorted by emotions and desires. Scientists were at that time working on similar lines and like them Cézanne perfected his methods of precise investigations—analysis—in order to obtain a true and balanced vision of the underlying structure of the world. His methods were not entirely new—see Dürer's drawing, **5**, page 95—but whereas in the past such ideas were used only on isolated occasions and for a particular purpose, they permeated the whole of Cézanne's work. They helped him to sort out the mass of impressions received by a human being and to retain only those of sufficient consequence. As time went on he eliminated more and more; his statements became terser and terser. Late paintings such as **3**, page 95, show us the basic structure of the world in visual terms. The visual exploration of nature initiated about the time of Giotto had entered a new phase.

pages 96-97 Pages 96 and 97 show pictures by Picasso. The top row consists of portraits, the centre row of landscapes, and the bottom row of still life paintings. Each starts with a phase which is clearly derived from Cézanne, then goes through a 'difficult' middle period (analysis) out of which a new reality is created.

pages 100-1 These pages show the interrelation between painting and architecture. The example chosen is the Villa Savoie designed by Le Corbusier in 1928. Even by the most modern standards it is a remarkable conception which seems to belong wholly to our time. This is a functional design of a very high order but Corbusier the artist was not content to leave it at that.

New building techniques (including one of his own patents) had enabled him to design and build a house whose outstanding visual feature was its apparent lightness. There are no heavy masses of stonework and glass is used liberally even for whole walls, while the outer walls of the house are broken up by long slots so that the general feeling of lightness is emphasised. This is further emphasised by the fact that the lower story is painted dark, leaving the slender pillars as the only visual evidence of support. But the very structure of the building itself—glass and concrete—transfixed by circular pillars and spiral staircases with its suggestion of interpenetrating forms is akin to the visual thinking of the period. It would be difficult to decide whether the artist or the architect in Le Corbusier had the greatest say in this design.

page 102 Renaissance space was explored from the position of a stationary observer; central perspective presupposes a fixed point of view. But in modern times this device has lost its usefulness. The analysis of form and space led to the abandonment of a fixed point of view and the introduction of movement (page 97). In the calm and still world of Giovanni di Paolo, **2**, page 102, movement seems strangely out of place. On the other hand, it is more in tune with the spirit of the Baroque. The delightful movement of the couple in the Watteau painting on page 102 has its counterpart in the movement of the putti on the left. Even the posture of each individual couple has the suggestion and anticipation of impending movement (for instance the second couple from the right, with its lines of force running through the arms of the lovers).

pages 103-6 By the middle of the nineteenth century movement had become an obsession—almost each week new forms of transport were patented, most of them inefficient and even ludicrous. In this mental climate, in which the description of movement for the purpose of study was no longer left to the haphazard methods of the past and new, precise methods of recording were evolved, artists also began to understand how to incorporate movement into the visual description of the world. The notion of the line not so much as a contour of a solid form but as the path of a moving body made its appearance about the end of the nineteenth century. It can be seen that such methods could describe with great clarity not only the movement itself, but also its character. Two different movements could be shown for comparison side by side in much the same way as two forms could be juxtaposed. The parallelism between science and art in these developments is obvious. Duchamp's 'Nude Descending a Staircase' and Boccioni's 'Walking Man', page 105, are explorations, analyses and descriptions of the visual world in much the same way as Giotto's and Cézanne's paintings, but they take in an extra dimension—time—which has become part of our conception of the world. The old ideas of static form as represented in the works of art and of science of the past were destroyed by the addition of the time dimension and its relation to movement. Einstein's Theory of Relativity is a near contemporary of these works.

Although most people are quite unaware of the existence of these works and ideas they cannot be dismissed as irrelevant to the life we lead and experience. Our visual communications are very much derived from the works of pioneers like Duchamp (page 106). This is exemplified by posters and visual instructions of all kinds. It would be a good exercise for pupils to collect material to show how the portrayal and experience of movement has become more and more important. (The Citroën prospectus, **6**, **7**, page 71 is a typical example.)

In addition to the analysis of form and movement the investigation of the human mind likewise made great strides forward during the nineteenth century, and entered a new—analytical—phase. What the analysis of form did to our concepts of form, the analysis of the human mind did to our age-old ideas about human emotions and motives. The outer skin of superficial, civilised values was pierced and the inner savage was found to be much more active than had hitherto been supposed. The example given at the beginning of the second paragraph on page 107 is taken from Gombrich's *The Story of Art* and is a good way of explaining simply the irrational in most of us. Surrealism and much of the art of our time must be approached with this in mind. *page 107*

The analysis of form and space and of movement, and the analysis of the human mind are not idle pursuits carried out by artists and scientists who are interested in the analyses for their own sakes; they have added to our experience of life. We may not be aware of the analyses or their findings, but there can be no doubt that these developments have affected our mental climate very deeply and given it a quality different from those of other periods. If we describe the Renaissance view of man as that of a complicated mechanism in a setting of space, the modern view of man is that of a sentient perceptive mechanism, motivated by forces which we do not fully understand, in a moving, changing universe.

pages 114-21 The film is a modern art form not only in the sense that it was invented in modern times and is based on modern technology, but also in that it forms an important part of our visual language, with its capacity to portray movement and the subconscious. Pages 114 to 121 show some of the technical devices peculiar to film-making and the purposes for which they may be used. Discussions of all types of film from this point of view should be encouraged.

No exercises have been set for chapter 5 because the field is so wide and each teacher will want to stress and explore his own particular field of interest. Exercises 4, 6 and 7 for chapter 4 could be suitably re-worded to apply to this chapter; for instance 'What are the main differences between the visual languages of the twentieth century and the Renaissance?' 'List the visual devices used by Picasso in "Guernica" which make it a true twentieth-century painting'. 'Explain why the Villa Savoie by Le Corbusier (pages 100-101) could not have been built during the Middle Ages.' Many other possibilities will suggest themselves.

Conversely the elements which make modern things modern could be discussed in relation to a number of objects. Analysis of form which leads to simplification and stresses the important parts only can be seen in the structure of Barking station, page 48, the road sign, **11**, page 62, and the painting, **10**, page 97. Preoccupation with movement is evident in **4**, page 27, **6**, page 69, **4**, page 70, **7**, page 71, and with the passage of time in **8**, page 71. The abandonment of a superficial outer reality in favour of a more essential inner reality is shown by **7**, page 69 and **5**, page 62. The selection of a part to symbolise the whole is exemplified by **1**, **2** and **3**, page 70. Whether such studies are carried out in conjunction with visits to picture galleries and museums, with architectural outings or displayed collections of various items of graphic design, the aspects of twentieth-century thought and art discussed in this volume of Looking and Seeing can be considered in a manner commensurate with the capabilities and achievements of any group of pupils. Another important point to be discussed in connection with graphic design is the multiplicity of points from which the scene or object is viewed and often the absence of any definite viewpoints altogether. At the same time many of the general principles discussed in previous volumes should also be given due prominence, such as the enlargement of our visual awareness of our environment due to science and technology (pages 32, 33, Pattern and Shape) and the proper use of materials.

Misuse of our own visual language should also be noted. Judging from the level of achievement of, say, the Salgina Gorge bridge by Robert Maillart, **3**, page 19, or 'Guernica' by Picasso, **5**, page 113, in which scientific and emotional efficiency (both in terms of the twentieth century) are combined, most items of our environment still seem second-rate. The collection on pages 124 and 125 could be suitably enlarged together with the reasons why these objects conflict with our visual language. The more reckless type of advertising and marketing, as well as sheer incompetence, can be seen to play an important role and could form the basis of a profitable set of exercises.

Conclusion

As the nineteenth century progressed, the harmony between thought and feeling which had given previous periods their visual languages was gradually lost. This disharmony was typified by the scientific concepts of the day: human beings were thought of in mechanical terms, as an assembly of parts comparable to a machine. Today, when many far-reaching scientific discoveries are revealing hitherto unsuspected aspects of the physical world, we are getting much nearer to a true understanding of the subtle relationships between man and nature and within man himself.

The human nervous system, which had in the nineteenth century been regarded as a complicated but straightforward system of communications, turned out to be an arrangement of unsuspected complexity, incorporating compensating devices of which nothing was known before the modern scientific era. That part of the nervous system which is now called the *somatic nervous system* deals with the body's physical exertions in relation to the outer world, such as walking or writing and all other voluntary actions. The *autonomic system* on the other hand, controls the subtle and abstruse inner functions of the body, the activity of the heart, the distribution of energy, the balance of organs, the inner reserves and the processes of regeneration. These two systems whose working is essential to the smooth functioning of the human organism are always in a state of balanced interplay mediated through the activity of a part of the brain called the *hypothalamus*, which ensures that the demands of the two systems are fairly met within the limitations of the body's resources; blood circulation, body temperature, respiration, the secretion of glands, etc., all these are correlated to the muscular and mental effort of the body. In this way the sometimes incompatible demands and conflicting interests of the somatic and autonomic systems are brought into harmony in order to preserve the physical balance of the individual.

The function of the hypothalamus on the physical level is paralleled by art on the mental level. We have already seen that art acts as an interpreter between the conscious and subconscious, so that an understanding between the two levels of the human mind may be arrived at and their activities correlated. Art is in fact a system which brings about a mental balance and its evolution can be seen as a natural process. In the past the integration of the individual and of society was largely achieved through the intermediary of various forms of art. Such integration is seldom achieved in modern life for art has been effectively separated from everyday existence, creating a state of imbalance. The erroneous idea of art as an inessential luxury is quite widespread but nothing could be further removed from the truth. We are no longer involved in art, we merely appreciate it. Most of us look at it from the outside as an amusing and often interesting phenomenon whose laws are strange to us and whose worth we cannot assess. The symptoms of stress and of anxiety normally associated with modern life are due not so much to the rattling of machines but to the separation of thought from feeling which occurs when art, the hypothalamus of the mind, is not allowed to wield its power.

As mass production and its attendant over-specialisation invade every part of life, as our experience of life becomes ever more fragmented into many different facets which the individual finds difficult to see as a whole, our need of art in all its forms is growing greater. In this the visual arts seem to be of especial importance, for they form our environment with its constant influence on the shape of our lives. 'We shape our buildings and later our buildings shape us.'

FOR FURTHER READING

Geometry of Art and Life, by Matyla Ghyka (Sheed and Ward Inc., New York), from which a few of the illustrations for chapter 1 were drawn, will be interesting to all those who wish to go deeper into what may be termed the mathematics of aesthetics. *The Modulor*, by Le Corbusier (Faber), now available as a paperback, gives an insight into the complexities of such an apparently simple scale. There are numerous publications issued by the Department of Scientific and Industrial Research which explain the idea of human design. The series *Ergonomics for Industry* is particularly applicable to chapter 2. *Vision in Motion*, by Moholy Nagy (Theobald) has already been referred to in the Teacher's Notes for Part Two. It must now be emphasised that it is an important work which should be read and re-read from time to time; it is also a good reference book. Although some of the details are now a little out of date the principles are as valid as ever. It is relevant to all the chapters of the present volume of Looking and Seeing. *Theory and Design of the First Machine Age*, by Reyner Banham (Architectural Press) is a history of the Modern Movement and could be used in conjunction with chapter 5, especially in sixth-form study. *The Scope of Total Architecture* (Allen and Unwin) is a set of essays by Walter Gropius and deals with some of the important issues facing the architect and designer. *Teaching and the Film*, by Petersen (Unesco) is an indispensable book to any teacher who wishes to make his pupils aware of the potentialities of the film. *Artistic Theory in Italy 1450-1600*, by Anthony Blunt (Oxford Paperbacks) describes some of the more important artistic values and ideas which were responsible for and resulted from the Renaissance. *Mechanisation Takes Command*, by Siegfried Giedion (Oxford) is an extensive study of the parallel development and mutual effect of ideas and technology. The simile on page 50 is in part derived from it.

PICTURE SOURCES

front endpaper

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pages 2-3

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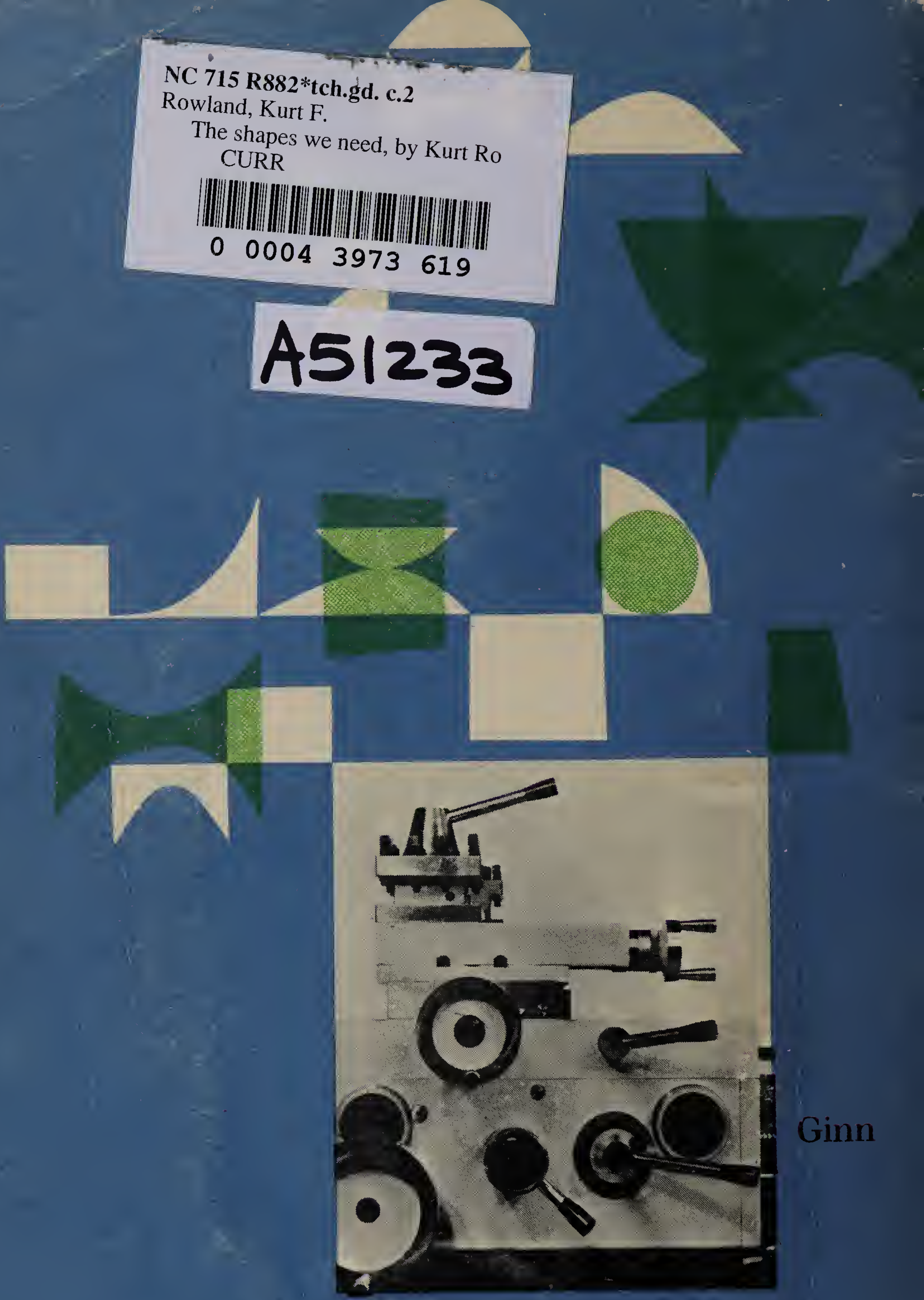

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